Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

MORPHOLOGY OF SPATHYEMA FOETIDA

JAMES ELLIS GOW

(WITH SEVEN FIGURES)

During the late winter and the spring of 1906 the writer collected, in the vicinity of Blairstown, N. J., the material on which the following observations are based. The anthers of Spathyema and the portion of the receptacle in which the ovary lay imbedded were cut out, killed, and fixed in picracetic,[1] chromacetic, or picric acid, imbedded, sectioned, and mounted in the usual manner. The stains used were safranin, Delafield's haematoxylin, and Haidenhain's iron-alum haematoxylin. Of these the last gave by far the best results.

During the summer the buds which give rise to the plants of the next year develop on the thick underground rootstocks. By November the shoots are several inches in length. The flower buds occur as lateral offshoots of the leaf bud, in the outer integuments of which they are enclosed. Only one flower makes its appearance in connection with each shoot. Occasionally this one is lacking, and the leafy shoot appears alone.

THE MICROSPORANGIUM.

During February growth is resumed in the flower bud. At this time the single anatropous ovule makes its first appearance in the form of a group of cells projecting obliquely downward into the cavity of the ovary. The stamens appear as short projections from the surface of the receptacle. The filaments do not begin to lengthen until considerably later. The anthers at this stage of development have not attained their full size, but the four microsporangia and the connective may be readily distinguished by the naked eye. Upon making a microscopic examination of the anther in cross section it is seen that the various portions are already well differentiated. Through the middle of the rather thin-walled cells forming the connective runs a well defined vascular bundle. The whole anther is invested by a layer of epidermal cells whose outer surface is somewhat thickened. In the interior of each microsporangium is a mass of thin-walled sporogenous cells (usually fifteen to twenty), indicating that the archesporial cells have developed some time before. These are surrounded by a well-defined tapetal layer. The four microsporangia are borne on the ventral surface of the stamen.

---

[1] A saturated solution of picric acid to which is added 1 per cent. of glacial acetic acid.

During the latter part of February and the first week in March the anthers increase greatly in diameter. This increase does not take place in the length of the connective so much as in the size of the four microsporangia. The connective appears to have reached its full development earlier. The growth of the microsporangia is accompanied by rapid increase in the number of sporogenous cells. While in a resting condition, the sporogenous cells differ from the surrounding cells in their greater size, in their generally hexagonal shape, and in the fact that the nucleus is larger in proportion to the size of the cell and shows a more distinct chromatin network than does the nucleus of the vegetative cell. Division of the sporogenous cells continues until they form, taken together, two-thirds of the diameter of the microsporangium. The last cells formed are considerably larger than those formed in the earlier stages of the process.

While this is going on, the filaments begin to lengthen out and push the anthers up until they press against the infolded edges of the perianth. By the second or third week in March the divisions of the sporogenous cells are completed. The mature pollen mother cells thus formed are from one and a half to two times the size of the cells from which they have descended. The tetrad formation is as usual. The walls of the spores are greatly thickened and do not stain readily with any of the anilin stains.[2] The cytoplasm is granular and the nucleus ill-defined. From the difficulty experienced in finding material in this stage of development, it is evident that it is very evanescent.

An examination of the pollen grains in water shows that the exine is of appreciable thickness (though much thinner than the wall of the cell in which it was developed) and is covered with minute spiny projections. The vegetative and generative nuclei appear faintly when the interior of the grain is brought into focus. When the pollen grain is treated with a solution of iodine green they appear much more clearly, and it is seen that the latter is much the larger of the two. The division between the two takes place just before the expulsion of the pollen grain from its investing cell.

---

[2] Staining the tetrads with haematoxylin was not attempted. Sections fixed in picric acid and stained with eosin showed the fibrous portion of the anther stained bright orange, mature pollen grains deep red, tetrads light yellow.

After the expulsion of the pollen grains the collapsed mother cells may be seen lying about and partially filling the cavity of the anther; but in a day or two they break down and disappear. Simultaneously with the disappearance of the mother-cell walls, the tapetal layer breaks down and the contents of the cells become scattered throughout the cavity of the microsporangium. By the beginning of the last week in March the microsporangium is filled with a mass of mature pollen grains. In the meantime the filaments, as a rule, have lengthened sufficiently to push the anthers out past the infolded edges of the perianth. When this has taken place the anthers dehisce and the pollen grains are set free. Frequently, however, the lengthening of the filament is delayed and the mature pollen grains remain in the anthers for a week or more before they are finally set free. This is a phase of the subject that must be reserved for future study, but it would seem that the development of the filament and dehiscence of the anther are dependent to a certain extent on weather conditions. Probably, too, there is a correlation between their development and the development of the pistil. The dehiscence is along two longitudinal creases, each one of which separates the two microsporangia lying at the same end of the connective.

THE MEGASPORANGIUM

Material gathered early in February shows the ovary as a tiny cavity in the tissue of the receptacle, beneath the short thick style. The ovule at this period appears as a group of thin-walled, undifferentiated, strongly nucleate cells, projecting downward into the ovary and nearly filling it. As yet there is no distinction of nucellus and integuments. The style has pushed up far enough to bring the partially developed stigmatic cells even with the edges of the sepals.

By the last week in February the cavity of the ovary has considerably increased and made room for the growing ovule. At this point the differentiation between the nucellus and its integuments begins to be noticeable, but as yet there is no division between inner and outer integuments. By the first or second week in March the outer integument begins to appear, and the inner integument grows up so as nearly to cover the nucellus, leaving only a narrow micropyle above its tip. An examination of the nucellus at this stage shows that it is invested by a distinct outer layer of cells differing from the interior cells in their greater regularity of outline. The cell at the tip of the nucellus and immediately under this investing layer is the archesporium (*fig. 1*). At this stage it differs from the surrounding cells neither in size nor in the nature of its contents, and can only be distinguished by its position.

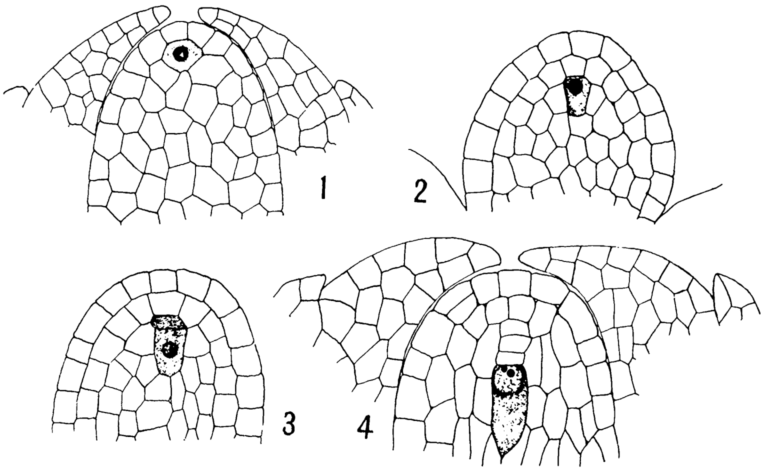

FIG. 1.—Ovule, showing archesporial cell. FIG. 2.—Same, after formation of two epidermal layers. FIG. 3.—First division of archesporial cell. FIG. 4.—The row of megaspores. All ×350.

As the nucellus grows, the cells of the outer layer divide, forming two layers outside the archesporium (*fig. 2*). The latter then divides transversely, cutting off a narrow tapetal cell (*fig. 3*). Up to this point the archesporial cell has undergone very little increase in size, but now the primary sporogenous cell begins to lengthen downward rapidly, crowding the cells in the base of the nucellus, some of which break down. At the same time it undergoes two more transverse divisions, forming a row of three megaspores, the innermost of which functions (*fig.* 4).

The reduction division and the successive divisions up to the fertilization stage of the embryo sac proceed as usual (*fig.* 5–7). In the reduction division eight chromosomes were observed, and sixteen were counted in the vegetative cells. During the maturing of the embryo sac, it lengthens and becomes from one and a half to two times as long as it was at the first division of the megaspore nucleus. The increase is all toward the chalaza, with very little lateral increase. In fact, as the sac elongates it frequently contracts in the middle.

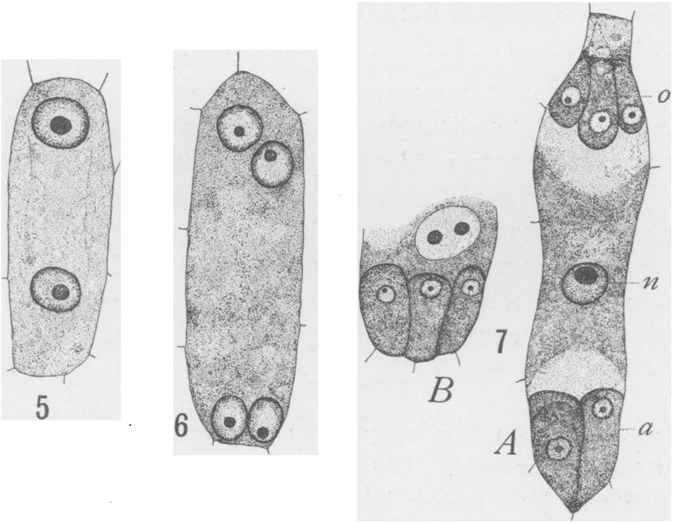

FIG. 5.—First nuclear division of embryo sac. FIG. 6.—Second nuclear division of embryo sac. FIG. 7.—*A*, mature embryo sac; *o*, oosphere; *n*, primary endosperm nucleus; *a*, antipodal cells; *B*, antipodal cells, and endosperm nucleus with two nucleoli. All ×900.

Of the material examined early in March, very few ovules were found in which the division of the archesporial cell had taken place. In many of the ovaries examined about April first the embryo sac was in the fertilization stage.[3]

---

[3] I give the earliest date at which the plant develops to the stage of growth described. As a matter of fact, many plants are belated, and flower buds may sometimes be found in the middle of April still unopened; but this is exceptional.

FERTILIZATION

The process of fertilization takes place during April or early in May. It may follow quickly upon the completion of the division of the nuclei in the embryo sac, or the latter may remain for several weeks before being fertilized. All depends upon the accident of pollination. Spathyema is fertilized by the agency of insects, especially certain spiders which make a practice of spinning their webs inside the spathe and flies which are attracted by the rank odor of the plant.

The exact length of time required for the penetration of the pollen tube into the embryo sac was not determined. The stigmatic surface consists of a mass of loosely compacted cylindrical cells, thin-walled and not distinctly nucleated. Four vascular bundles run through the thick pyramidal style, corresponding to its four angles. The central portion of the style consists of a loose mass of thin-walled cells, through which the pollen tube readily forces its way to the upper end of the ovary. It then follows either the inner surface of the ovary or the outer surface of the integuments of the ovule until opposite the micropyle, through which it passes.

THE EMBRYO

After fertilization, the oospore by transverse divisions forms a proembryo of four cells. The terminal cell then divides longitudinally, followed by a second longitudinal division at right angles to the first. Each of the four terminal cells then divides transversely. The most advanced material examined during the second week in May showed the embryo in this stage of division. Beyond that point it has not as yet been possible to carry the investigation.

BLAIRSTOWN, N. J.